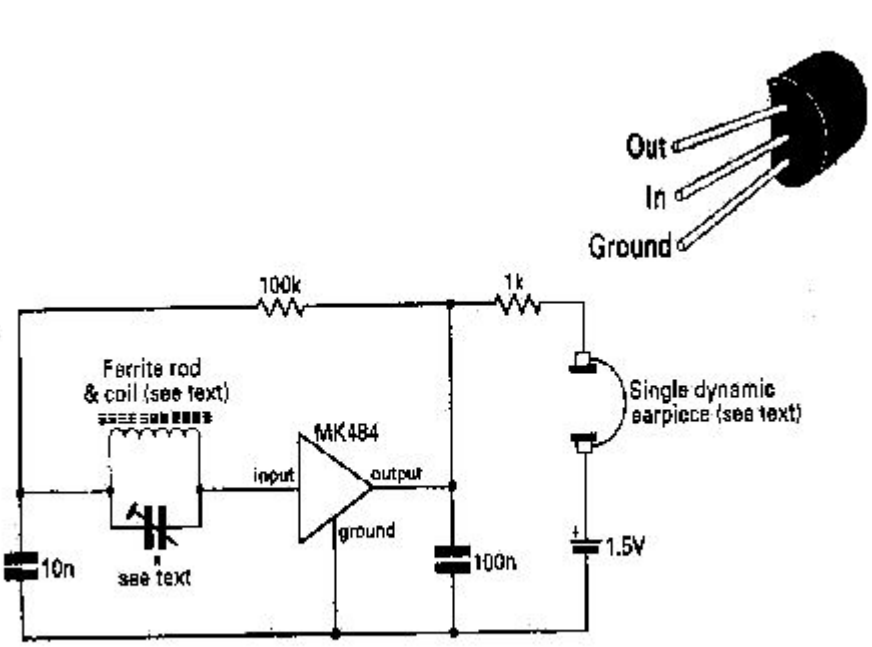
A simple MK 484 IC tuned rf (trf) radio

(updated 4 Jun 01)

In 1970 Ferranti started the development of a single-chip AM tuner, and by 1973 it became widely available for use. The 414 is no longer in production, but a follow on IC, the MK484 recently became available, and incorporates essentially the same features. It is a 3 terminal device which packs ten transistors providing 3 stages of rf amplification with an input impedance of about 4 Megohms, and giving 72 dB of gain with about 30 millivolts of audio output (rms). Thanks to the editors of *Practical Wireless* a ham magazine in the UK, and Dr. Philip Miller Tate of Kingston University, who has probably built a dozen or so of these in one guise or another, and sent me one fully assembled, here is one adaptation of this versatile little chip which gives you a nice little portable radio which is stable and virtually idiot proof to build, needs only a 1.5 v battery, and requires a tiny thimble full of parts to give you near-superhet performance. Here is the schematic of the circuit that *PW* came up with:



The frequency range of the chip is about 200 kHz to 3 MHz. The coil/capacitor selection for the tank circuit should fall into this range. For small size and shirt pocket portability, you can use a ferrite core coil as shown. I have tried it with a variety of tank coils, and they all work fine. Notice there is no antenna - don't need one. I have found that the set "likes" to have a ground connection. You can improve reception somewhat with an external antenna and ground, but do so lightly; I found that a small antenna coupling coil connected to antenna and ground in the vicinity of the tank circuit, loosely coupled, works nicely.

While the designers had in mind a pc board assembly, I have found that "dead bug squashed flat" works well too; so did the *PW* staff, as you could see by the rendition on their technical features page. Phil used a small masonite board and epoxied brass strips on it to make his solder connections (see it at Xtal Set Photos by Dr. Whiz). Mine was assembled on a 6 lug tie strip, which was then screwed into a board.

Now for some notes and fashion tips on putting this together and using it:

100 nF = 0.1 uF (that's a 104) 10 nF = 0.01 uF (103)

The dynamic earpiece mentioned can be one of the balanced armature types found in sound powered headsets (and most telephone earpieces - don't tell Ma Bell I told you). I used successfully magnetic earphones; 2000 ohm phones, if used, can replace the 1 kohm resistor. I also tried a 1 kohm dynamic earplug from Mouser, also replacing the 1 k resistor, and it worked, but it is not a very sensitive plug, and is not recommended except "in town". I also used a high impedance crystal earphone across the 1k resistor with good success - I think a 1.5 k

resistor worked a little better, however.

You can connect a small audio amp to this set, connecting it across the 100 nF capacitor - the input capacitor to the amp should be about 100 nF.

Did I mention that this chip incorporates automatic gain control (AGC)? The resistance between the (+) side of the battery and the junction of the 1 k and 100 k resistors determines this, and you might want to play around with this a bit, depending on how you get the audio out. If you feed an audio amp with the set, the 1k AGC resistor might need to be adjusted, but don't go below about 500 ohms. The AGC and the Q of the tank circuit pretty much determine the ability of this set to perform as well as it does. Even with rather strong stations nearby, you will be slowly tuning and hearing a strong station in the background, all over the dial, so to speak (remember, this isn't a superhet), and then a station will pop up clearly out of the background noise. You can also null the strong locals a bit by turning the set so that its coil is pointed in a quieter direction. This set might be neat to use with a loop antenna for the coil.

You can get this set to oscillate (I did it when playing around with the AGC), but you don't want it to. You should separate the power and audio leads from the tuned circuit, and keep your leads short (separated is perhaps more important than short - I used long clip leads to connect different coil/cap combinations to the set).

Don't buy a new battery - this baby only draws a half a milliamp when its cooking. With a spanking new alkaline battery, the high gain front end is susceptible to oscillation, and a higher value R1 might be needed.

Austin Hellier from down under posted this on Rap 'n Tap for those of you looking for some mods to this simple rig which he claims will improve its performance - takes only a couple of 1N914 diodes and a bit of wire to accomplish:

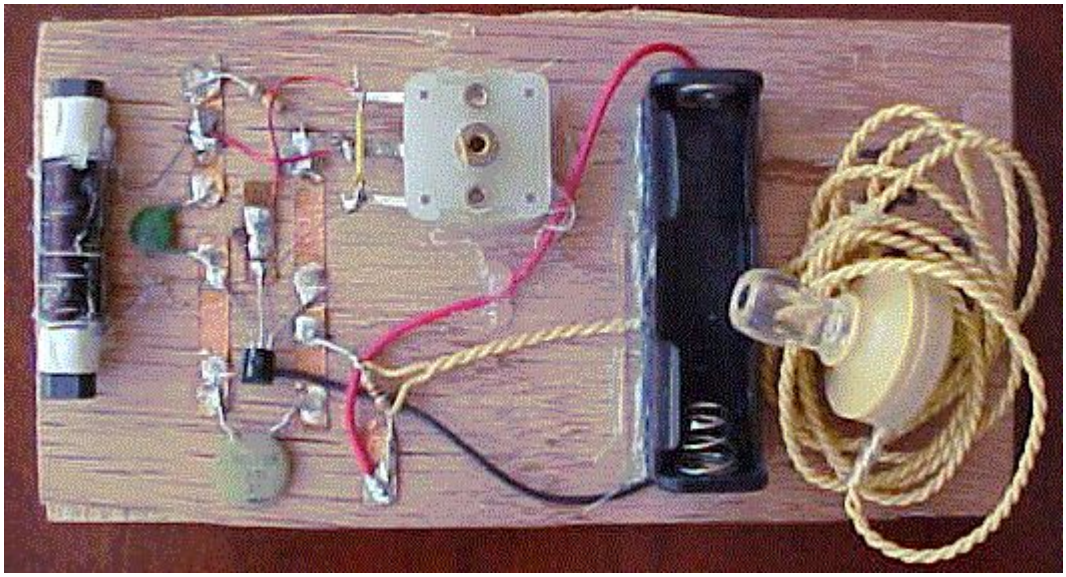
"Thought you might be interested in a couple of mods for your MK484 receiver - these have proved very popular over here in Australia - Dick Smith Electronics puts out their Funway 1 series, and one of the projects is this kind of receiver, driven from a simple cell made of zinc coated nails, copper strips and - good old Aussie beer...

Now to the mods - take two 1N914 diodes in series from pin 1 to ground - this ensures no overvoltage to the chip - then take a 1K5 resistor to the 1.5 volt battery. You can use a 6K8 resistor instead, if you want to use a 9 volt battery.

Instead of using a single winding and parallel polycap, I use an inductive coupling method. Five turns of telephone jumper wire (brittle stuff, easy to work with though) and connect that between the junction of the 100K/0.01u - the other end goes to pin 2. Both ends of the main winding (50 turns around a 100 x 9mm rod in parallel with a 220pF cap)is then floating free from the rest of the circuit. This prevents loading of the tuning circuit, prevents acoustic feedback, and the volume, clarity and selectivity have to be heard to be believed - hope this helps you and your students, club, friends etc."

I suspect that either of the two modifications will improve the set. However, the diode trick will cost you some battery life, and the inductive coupling does cut down on the sensitivity with the unadorned set.

You Elmers can go HERE for a layout and construction instructions I use with my students.
Oh yeah, here is a picture of the "student model, without the battery installed or the capacitor knob. The base shown is 3 x 6, but I use 3 x 5 with the students; this is the prototype. Assembly time with prepared coil and capacitor was about 1.5 hours for very novice builders.



Suppliers of the MK 484:

Kanga , a UK supplier will sell you the chip for a pound note plus S&H.

Dick Smith Electronics has it listed at $2.29 AUS; get ten, they're cheap, and get your cub scout pack involved, or have a building contest at your next ham club meeting.

Ocean State Electronics has a pricey ZN414 listed.

If you run across any 414s, you can build the set here, just remembering that the pinout for the 414 in the TO92 case is reversed from the 484 above, center is still input. For the 414 in the TO39 case, the output is next to the metal tab, input is in the center, same as the base for a bipolar xistor, etc.

Once you have this one running, modify it slightly for more flexibility and dx by going HERE .

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